

X23a JWST-ALMA Joint Efforts on Calibrating Gas-Phase Metallicities of Star-Forming Galaxies at $z > 6$

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Accurate measurements of gas-phase metallicities and stellar masses at $z > 6$ are crucial for understanding the formation and growth of early galaxies, but these measurements were not feasible with telescopes before JWST due to their limited sensitivities and wavelengths. In this talk, we will overview our JWST program (GO-1657: PI: Y. Harikane, co-PI: R. Sanders), which will take deep NIRSpec and MIRI IFU spectroscopy and NIRCам photometry targeting three galaxies at $z_{\text{spec}} = 6.0 - 7.2$ covered by ALMA [OIII]88 μm observations in order to derive gas-phase metallicities at $z > 6$ using the reliable direct electron temperature method. Although the direct method usually relies on temperature-sensitive auroral lines that are too faint to detect at $z > 6$, we will accomplish this goal by combining measures of the temperature-sensitive far-infrared fine structure line [OIII]88 μm (from ALMA) with rest-frame optical lines ($\text{H}\alpha$, $\text{H}\beta$, [OIII]4959,5007, and density-sensitive [OII]3726,3729 from JWST). Combined with the stellar mass measurements from the NIRCам photometry, our program will deliver robust measures of the mass-metallicity relation to $z \sim 6 - 7$ along with accompanying constraints on dynamical and gas masses, ionization parameter, and ionizing spectral shape. Finally, we plan to discuss the prospects from this program and other JWST programs to constrain the physical properties of galaxies at $z > 6$ to understand early galaxy formation and the sources of cosmic reionization.